THE

Engineering Record

BUILDING RECORD AND SANITARY ENGINEER

VOLUME 58

July—December, 1908

McGraw Publishing Co.
239 West 39th St.
New York

the open lake by a cofferdam of sufficient tightness to permit this area to be unwatered with a head of 18 to 20 ft. on the outside. A course of horizontal braces between the sides of the cofferdam and supported by intermediate piles, was placed before the water level was lowered; then, as pumps mounted on the cofferdam drew the water down, a second set of braces was placed 7 ft. below the first, and finally a third set at the bottom. After the water was removed a 4-in. Nye pump was able to keep the interior of the cofferdam practically dry during the subsequent operations.

An excavation of only a few feet in depth was required for the base of the crib, so this work was done by hand. The spoil was loaded into small cars which were pushed on narrow-gauge tracks, laid in the bottom, to within the range of a turntable derrick, mounted on the cofferdam. This derrick was then used to hoist them to the level of the top of the cofferdam so they could be run out on a track on the latter and their contents dumped into the lake, as practically nothing but sand was taken out. The 16-ft. shaft connecting the crib with the tunnel was made in open cut through the stiff blue clay, the latter being retained by tongue-and-groove wooden lagging, in 5-ft. lengths, until the concrete lining could be placed. This lagging was set up vertically in horizontal courses, which were retained in position by iron rings, the lagging being left in place back of the concrete lining. The shield used in driving the tunnel had been carried beyond the base of the shaft, and a bulkhead built up back of it. The connection between the shaft and the tunnel was therefore made without incident.

The crib contains upwards of 7,000 cu. yd. of concrete, which was mixed in a plant built up on the leeward side of the cofferdam. The concrete was made in the proportions of 1 part Universal Portland cement 3 parts sand and 6 parts broken stone. The materials were delivered in scows, from which they were unloaded into supply hoppers at the mixer by a turntable derrick. The mixer discharged into dump cars, which were operated on narrow-gauge tracks to various parts of the work, or into bottom-dump buckets handled to place in the forms by a second turntable derrick.

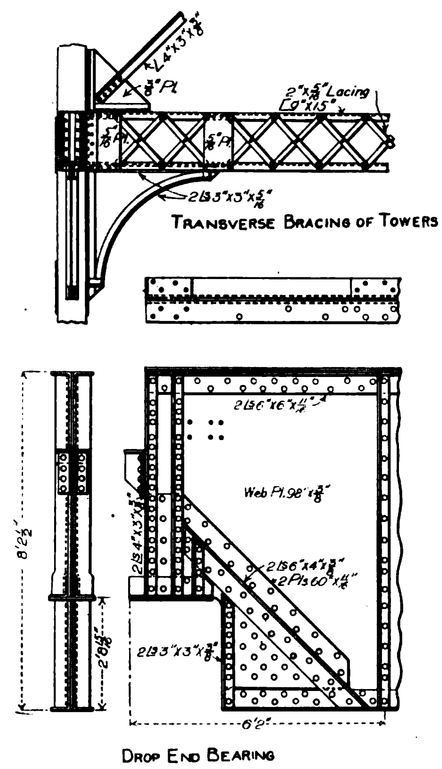
The intake crib and tunnel were designed and built under the direction of Mr. John Ericson, city engineer of Chicago, and Mr. William S. MacHarg, consulting engineer. This journal is indebted to Mr. R. A. Bonnell, assistant engineer, immediately in charge of the construction, for the data on which this article is based.

THE EXTERIOR V-SHAPED NOTCH in the face of retaining walls at expansion joints has been improved on in appearance in the walls built by the Delaware, Lackawanna & Western R.R. at Scranton, Pa., by making a quarter-round bead on each side of the joint. This causes no extra trouble, but adds much to the appearance.

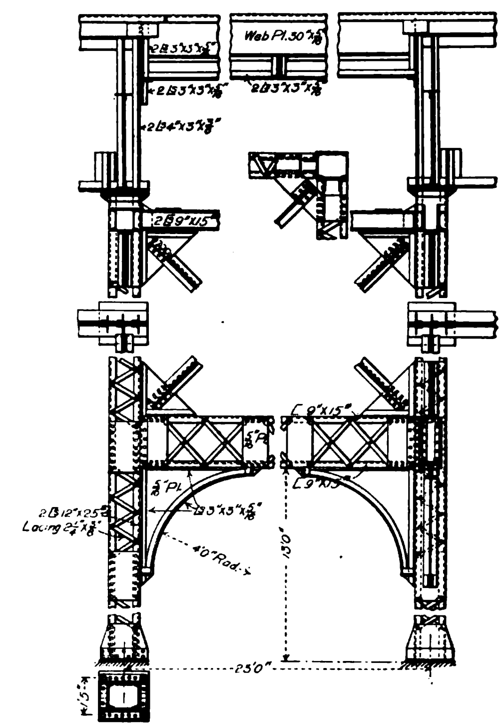
The Mercantile Bridge across the Monongahela River.

The Mercantile Bridge across the Monongahela River between North Charleroi and Wireton is 1,857½ ft. long between abutments and has a clear height of about 54 ft. above the center of the river which at this point is about 800 ft. wide and 20 ft. deep and is crossed by two 400-ft. through spans. There is also one 200-ft. shore span at a clear height of 22 ft. above four tracks of the Pittsburg & Lake Erie R. R., besides a plate girder approach viaduct at each end. The axis of the bridge consists of three tangents intersecting at the end piers of the main spans with angles of 1 deg. 23½ min. and 4 deg. and 47 min. There is a uniform grade of 0.66 per cent. reducing the clearance above extreme high water to a little less than 30 ft. in the center of the river. The main piers are of ashlar masonry with concrete hearting and pile foundations and the pedestals for the viaduct columns are of concrete. The roadway, about 23 ft. wide between curbs, has a wooden floor for vehicles and two tracks with girder rails for electric cars, and provision is made for two outside sidewalks 6 ft. wide, one of which is supported on cantilever brackets and the other may be added in the future if desired.

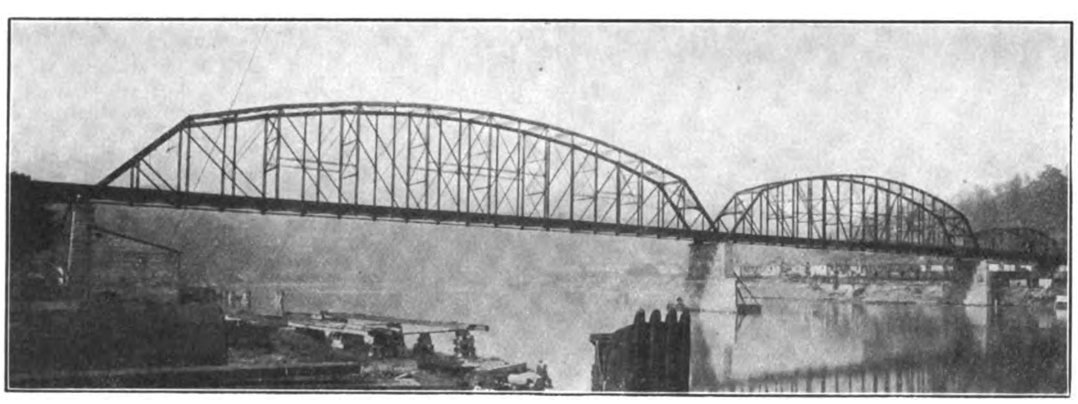
The 400-ft. spans are duplicates with pin-connected trusses 26 ft. apart on centers with a maximum depth of 65 ft. They are divided by verticals and sub-verticals into 20-ft. panels and are braced with the usual top and bottom chord lateral systems, each consisting of single and double 4x4-in. angle X-braces and with lower and intermediate horizontal transverse struts between vertical posts with X-brace angles in both of the two panels between them. The maximum top and bottom chord stresses are 1,004,000 lb. and 968,000 lb., respectively, and the corresponding members are made with two 24x13/16-in. web plates, two 4x4x½ and two 6x4x⅝-in. flange angles and one 26x7/16-in. cover plate and with two 8x1⅛ and four 8x1¼-in. eyebars. The vertical posts are all made with pairs of 10 and 12-in. channels latticed and both square and flat counter-rods in the center four panels are adjustable with sleeve nuts.



Girder and Tower Details.



Transverse Bent, West Viaduct.



Main Spans of Mercantile Bridge.

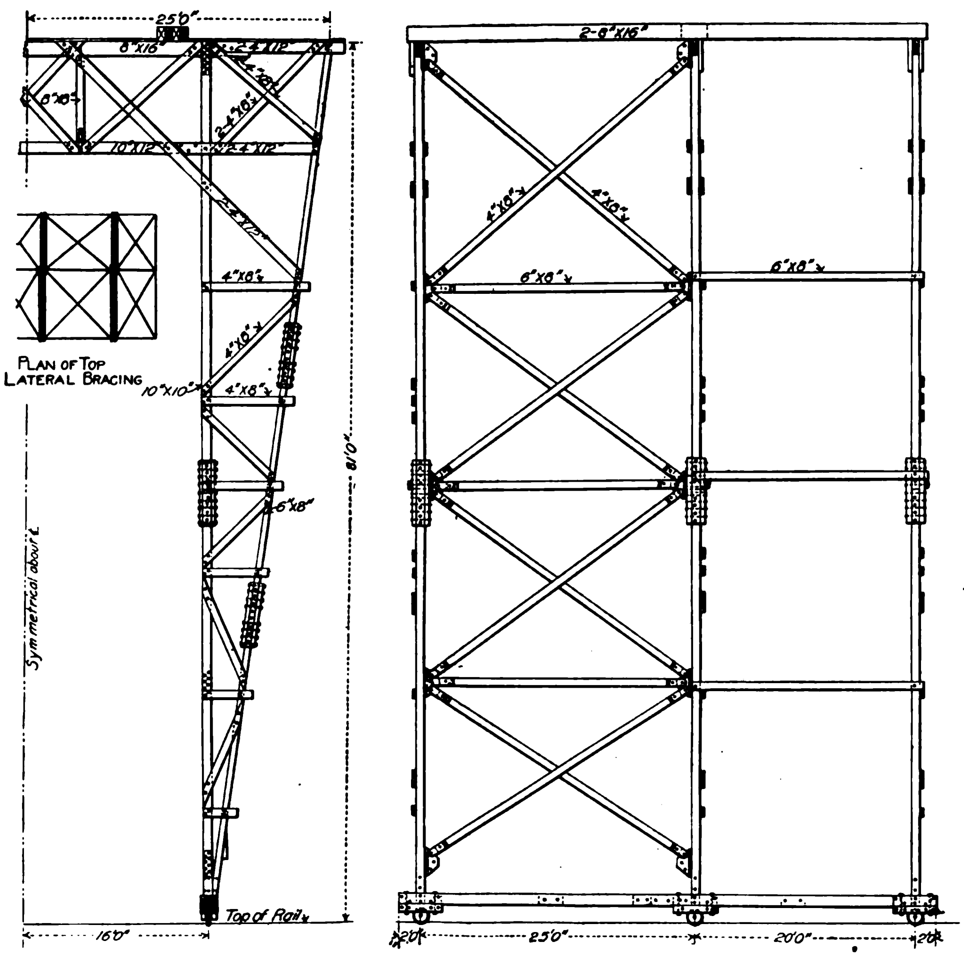
The 200-ft. span is similar except that the trusses have no subvertical posts nor longitudinal struts and are only 35½ ft. deep in the center. The sway-bracing consists entirely of light lattice girders occupying the entire space between the top chords and the clearance line which, as in the 400-ft. spans, is maintained uniformly 21 ft. above the lower chord pins. The maximum top and bottom chord stresses are 379,000 and 372,000 lb. and the corresponding members are made with two 18x⅜-in. web plates, two 3x3x⅜-in. and two 4x3x⅜-in. flange angles and one 21x5/16-in. cover plates for the top chords and two 6x15/16-in. and two 6x1 1/6-in. bottom chord eye-bars.

The details of the 200-ft. span correspond very closely to those of the 400-ft. span, all of which are substantially similar to those of the typical connections here illustrated. In the 400-ft. span the top chord is provided at the hip joint with two intermediate diaphragms with full hole bearings for the U2 pins which are separated far enough to afford clearance between them for a single diaphragm bearing plate in the top of the end post. None of the other chord pins have intermediate bearing diaphragms. The top lateral struts are in planes perpendicular to the inclined top chords to which they are field-riveted through top and bottom flange connection plates. The intermediate floorbeams are field-riveted to the flange cover plates of the vertical and subvertical posts through their vertical end web stiffener angles and are also seated on wide bottom flange shelf angles providing rigid attachments for the horizontal connection plates of the bottom lateral diagonals.

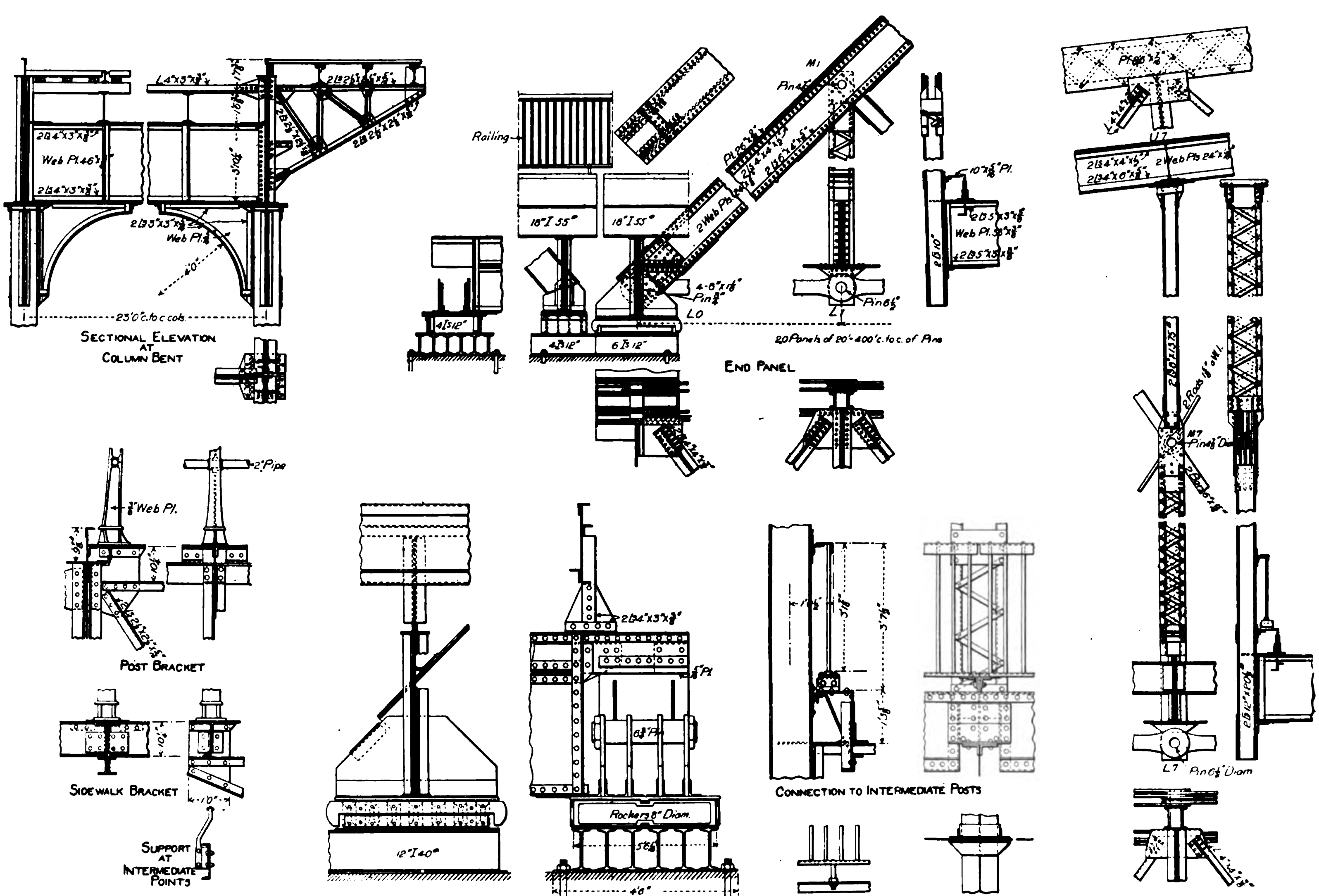
The intermediate floorbeams are all alike with a 38x⅜-in. full length web plate, 5x3x⅜-in. flange angles and two 12x7/16-in. flange cover plates 17 ft. 9 in. long. To them are web-connected four lines of 18-in. I-beam stringers under the track rails. The top flange angles are spliced with field-riveted cover plates between the channels of the vertical posts, to the top flanges of the sidewalk brackets and the bottom flange angles of the latter are connected with pairs of oblique bent plates field-riveted to the vertical posts. The top flanges of the end floorbeams are set about 20 in. lower than those of the intermediate floorbeams so as to receive across them the stringer I-beams. They are in the planes of the lower chord end pins and are notched to be seated on the incline end posts to which they are connected with field-riveted bent plates.

At the fixed ends the riveted shoes are seated directly on the steel grillages which distribute the pressure on the masonry, but at the expansion ends they are supported by nests of segmental cast-steel rollers 8 in. in diameter with interlocking top and bottom side bars to limit their angular displacement. The rollers are set on bed plates made with longitudinal 12-in. I-beam grillages, having ⅝-in. countersunk riveted top and bottom cover plates. The curbs are made with fascia girders 1 ft. 11½-in. deep having a rather unusual cross-section with a 3x4x3-in. zee bar for the bottom flange and a 3x3-in. angle and a 10x5/16-in. horizontal plate for the top flange. The fascia girders have the ends of the webs notched to allow them to drop over the floorbeams with which they are connected by horizontal angles seated on the top flanges of the floorbeams and field-riveted to the web splice plates of the girders. The horizontal plate in the top flange of the fascia girder is riveted to the vertical post and is supported intermediately with bent plate knee braces to the bottom flange which strengthens it to receive the riveted pedestals for the intermediate posts of the hand rail.

The viaduct at the east end of the bridge consists of six 60-ft. plate girder spans supported on vertical posts about 20 ft. high. There are two lines of girders 7 ft. deep and 23 ft. apart on centers that are seated, together with end floorbeams, on the horizontal caps of the vertical posts to each of which they are also connected with a solid web kneebrace bracket. In each span the girders are connected at the ends and at two equidistant intermediate points by the plate gir-



Traveler with Pin-Connected Braces.



Details of Truss, End Bearing and Hand Rail for 400-Foot Span and Section of Approach Viaduct.

der floorbeams 46 in. deep, flush with their bottom flanges and carrying the four lines of 18-in. I-beam stringers across their top flanges. All panels between floorbeams are X-braced with single 4x3x⅜-in. lateral angles riveted to their bottom flanges. Transverse 4x3-in. horizontal angles connect the top flanges of the main girders and of the stringers at the ends and at the center of each span. The longitudinal wooden floor joints and the rails are carried on 6x8-in. ties dapped over the stringers and supported at the end by shelf angles on the girder webs. The transverse floor planks rest on the joists and on the top flanges of the main girders and are carefully fitted at their ends against the webs of the fascia girders. The main girders are peculiar in that their web plates project 10 in. above the top flange angles and are stiffened by a single 3x3-in. angle to form curb girders.

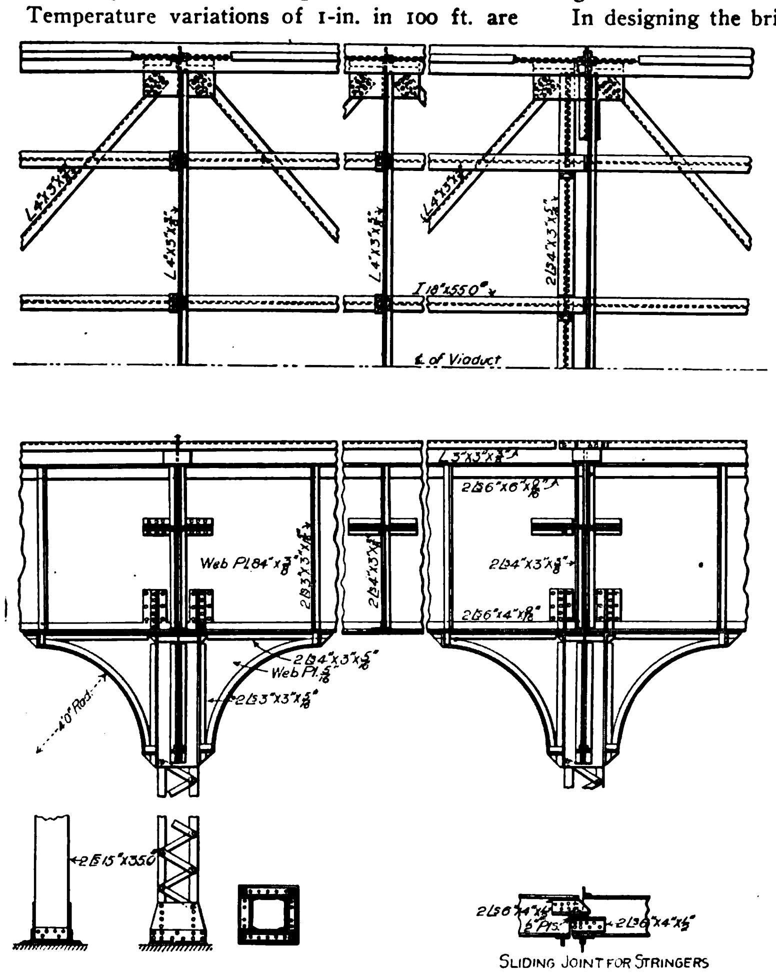
Temperature variations of 1-in. in 100 ft. are provided for throughout the entire structure by expansion joints for all longitudinal viaduct members which are located from 120 to 160 ft. apart at the ends of spans. The main girders all have sole plates riveted to their bottom flanges and resting on fillers beveled to suit the roadway grade. At fixed points they are riveted to the columns and at expansion joints they have slotted holes for shouldered bolts. There is a clearance of about 11½ in. between the ends of the girders and the web plates above the top flange angles are spliced with cover plates riveted at one end and bolted to slotted holes at the other end. The expansion ends of the stringers are made, as shown in the details, with drop ends and bearing angles riveted to the projecting webs so as to provide seats for them and also form jaws engaging the webs of the fixed stringers. The support for them is provided by reversed horizontal bearing angles riveted to the webs of the fixed beams and planed bearing plates are countersunk riveted to both members.

The viaduct at the west end of the bridge has six deck plate girder spans of 57 to 80 ft. supported on four towers and one single transverse bent. Each tower is made with four vertical posts 23 ft. apart longitudinally and transversely with top and bottom longitudinal and transverse struts and a single panel of X-bracing in each face. The bottom struts have a clearance of 13 ft. above the ground and are kneebraced at both ends with solid web portal brackets.

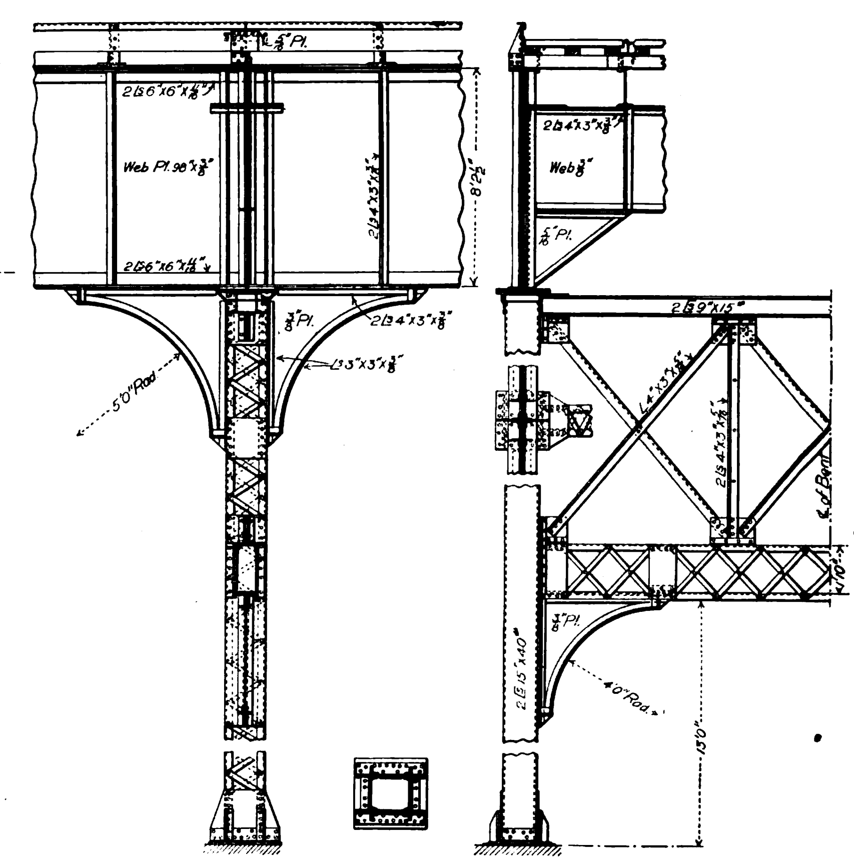
The single transverse bent supports the adjacent fixed ends of the two 80-ft. spans and corresponds essentially to one bent of a tower. The 80-ft. girders are 98 in. deep and are of ordinary construction with T-shape top and bottom flanges made with pairs of 6x11/16-in. angles and 16-in. flange cover plates. At the expansion end the lower edges of the webs are notched about 2 ft. 9 in. to rest on the tops of the towers and bring the top flanges flush with those of the 23-ft. span. The end panel web is reinforced by a pair of 11/16-in. cover plates and two 6x4-in. diagonal angles.

In designing the bridge care was taken to provide attractive posts and overhead brackets for carrying lighting fixtures and frames on the viaducts for trolley and other overhead electric wires. Supports for public service pipes were also placed under the sidewalk, where lines of pipes will neither be in the way of traffic nor unsightly. Often these attachments are neglected and in later years the bridge suffers much in appearance by laying pipes on the floor, where dirt and rubbish collect around them, and from building various contrivances of wood and gas pipe to carry wires. Alongside the bridge and just east of the Pittsburg, Virginia & Charleston R. R. tracks there is a tower on which is built a toll house at the sidewalk level and having a steel stairway down to the street level.

Mr. Emil Swensson is the chief engineer of the bridge and it was fabricated and erected by the American Bridge Co., of New York. The total weight of the steel superstructure is about 3,358,000 lb., which was erected in the ordinary manner with a gantry traveler and wooden falsework for the long span and with a "mule" or viaduct traveler for the plate girder spans. The Friday Contracting Co. was the contractor for the substructure.



Part Plan and Longitudinal Section, East Viaduct.



West Viaduct at Trestle Bent.

Utility of Waterways as a Factor in Transportation.

An address before the River and Harbor Convention at Washington by J. A. Ockerson, M. Am. Soc. C. E., of the Mississippi River Commission.

The development of the material resources of our country has so fully occupied our attention up to recent times, that we have given little heed to economy in the cost of transportation. Transition from wilderness and barren plain to cultivated fields and populous cities west of the Alleghenies, has occupied so brief a time that it finds no parallel in the history of the world. Vast deposits of mineral wealth have yielded rich profits to the miner and the forests have contributed much to our material prosperity. It is proper to say that railway extension has been a potent influence in this wonderful transformation. They pushed far beyond the confines of settlement and cultivation and became the active agents in the development of unoccupied territory, instead of waiting for such occupation and improvement as would provide sufficient tonnage to justify their construction and operation.

In all these busy years of converting to the uses of man the material resources which nature had lavished upon us, ample profits very generally rewarded the judicious investment of capital. Industry and energy received generous recognition. We made extravagant inroads on our resources, and economy in the cost of transportation was such a trivial matter under these flourishing conditions, that serious consideration was not given thereto. Hence our waterways, which are among our most valuable assets, were sadly neglected. They have not received the consideration which their merits deserve, and there is not even to-day any well-defined policy looking to their improvement and use.

We have reached a time where radical changes are necessary. Our natural resources of minerals and forests have been so depleted that measures for economy must be substituted for extravagant wastefulness. We face a condition which older countries long since came to realize,